National Institute of Standards & Technology

Certificate of Analysis

Standard Reference Material® 919b

Sodium Chloride

This Standard Reference Material (SRM) is intended for the production of saline solutions of accurately known concentration and the calibration of instrumentation and standardization of procedures used in the determination of sodium and chloride ions. A unit of SRM 919b consists of a single glass bottle containing 30 g of the material.

Certified Values: Table 1 lists the certified values for this SRM, expressed as mass fractions, *w*, of sodium chloride (NaCl), chloride (Cl^-), and sodium (Na^+). A NIST certified value is a value for which NIST has the highest confidence in its accuracy in that all known or suspected sources of bias have been investigated or taken into account [1].

Table 1. Certified Values[(a)] for SRM 919b Sodium Chloride

w_{NaCl}	99.835 %	±	0.020 %
w_{Cl^-}	60.564 %	±	0.014 %
w_{Na^+}	39.2747 %	±	0.0075 %

[(a)] Each result is expressed as the certified value ± the expanded uncertainty, *U*, calculated as $U = ku_c$, where u_c is the combined standard uncertainty calculated according to the ISO/JCGM and NIST Guides [2]. The value of u_c is intended to represent, at the level of one standard deviation, the combined effects of inherent sources of uncertainty of the assay techniques and applicable corrections for interfering trace elements. The value of the coverage factor, *k*, is 2, which corresponds to a level of confidence of approximately 95 %. The certified values for the mass fractions of Na, Cl, and NaCl are metrologically traceable to the SI units for mass, current, and time in the coulometric assay; to the SI unit for mass in the gravimetric assay; and to the derived SI unit kilogram per kilogram for mass fraction (expressed as a percent) for the corrections for trace elements.

Expiration of Certification: The certification of **SRM 919b** is valid, within the measurement uncertainty specified, until **01 March 2022**, provided the SRM is handled and stored in accordance with the instructions given in this certificate (see "Instructions for Storage and Use"). The certification is nullified if the SRM is damaged, contaminated, or otherwise modified.

Maintenance of Certification: NIST will monitor representative samples from this SRM lot over the period of its certification. If substantive changes occur that affect the certification before the expiration of certification, NIST will notify the purchaser. Registration (see attached sheet or register online) will facilitate notification.

Coordination of the technical measurements leading to the certification of SRM 919b was provided by K.W. Pratt and T.W. Vetter of the NIST Analytical Chemistry Division.

Coulometric and gravimetric analyses were performed at NIST by K.W. Pratt and T.W. Vetter, respectively. Trace element analyses by spark-source mass spectrometry were performed by a commercial laboratory.

Statistical consultation was provided by W.F. Guthrie of the NIST Statistical Engineering Division.

Support aspects involved in the issuance of this SRM were coordinated through the NIST Office of Reference Materials.

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Gaithersburg, MD 20899
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Certificate Revision History on Last Page

Steven J. Choquette, Acting Director
Office of Reference Materials

Information Values: Table 2 lists information values for selected impurities in SRM 919b. No other elements were detected at a mass fraction greater than 1 µg/g. Information values are non-certified values that may be of interest and use to the SRM user, but insufficient information is available to provide an uncertainty associated with the value [1]. Information values cannot be used to establish metrological traceability.

Table 2. Information Values for SRM 919b

Element	Mass Fraction (µg/g)
Br	15
S	10
K	7
Si	5
Ca	1
P	0.5
Al	0.4
I	< 25
F	< 5
Ni	< 2
Li	< 1
Mg	< 1
Rb	< 1
Ba	< 1
Cs	< 0.5

INSTRUCTIONS FOR STORAGE AND USE

Stability and Storage: This SRM should be stored in its original bottle at room temperature. It must be tightly re-capped after use and protected from moisture and light. At room temperature, sodium chloride is hygroscopic above 60 % relative humidity. It is recommended that weighing and other manipulations not be made when the relative humidity exceeds 60 %.

Homogeneity: This SRM is homogeneous within the uncertainty limits for the nominal sample mass, 170 mg, used for the coulometric assays. Samples less than 170 mg are not recommended, in order to avoid possible heterogeneity with smaller sample sizes.

Possible Interfering Species: It is the responsibility of the user to evaluate which species may interfere with the application of this SRM and to apply any necessary corrections that affect the given application. The following information and the values in Table 2 may be useful in this evaluation.

Corrections for trace elements were obtained from the spark-source mass spectrometric determinations and the appropriate gravimetric factors. A portion of the Na^+ is assumed to be present in SRM 919b as sodium sulfate (Na_2SO_4), sodium bromide (NaBr), sodium iodide (NaI), disodium hydrogen phosphate (Na_2HPO_4), and sodium fluoride (NaF); and a portion of the Cl^- is assumed to be present as potassium chloride (KCl), lithium chloride (LiCl), calcium chloride ($CaCl_2$), nickel chloride ($NiCl_2$), aluminum chloride ($AlCl_3$), magnesium chloride ($MgCl_2$), barium chloride ($BaCl_2$), rubidium chloride (RbCl), and cesium chloride (CsCl). Silicon is assumed to be present as silicon dioxide (SiO_2). Hence, the sum of the certified values for w_{Na^+} and w_{Cl^-} does not equal the certified value for w_{NaCl}.

The certified value for w_{NaCl} is obtained from an equally weighted combination of the results of the gravimetric determination of NaCl, with appropriate corrections for trace elements; and the results of the coulometric determination of NaCl, with appropriate corrections for trace elements.

The certified value for w_{Cl^-} is obtained from an equally weighted combination of the results of the coulometric determination of Cl^-, with corrections for interfering bromide and iodide; and the results of the indirect determination of Cl^- obtained from the gravimetric determination of Na^+, with appropriate corrections for trace elements.

The certified value for w_{Na^+} is obtained from an equally weighted combination of the results of the gravimetric determination of Na^+, with appropriate corrections for trace elements; and the results of the indirect determination of Na^+ obtained from the coulometric determination of Cl^-, with appropriate corrections for trace elements.

Coulometric measurements of SRM 919b ignited for 3 h at 600 °C and measurements of change in mass on ignition each indicate the presence of (0.16 ± 0.02) % inert volatile material, presumably occluded water, which is volatilized on ignition. This value is a reference value [1], which is a best estimate of the true value, where all known or suspected sources of bias have not been fully investigated by NIST.

Drying Instructions: Dry for 3 h at 110 °C. After the SRM has been dried, store it in a desiccator over anhydrous magnesium perchlorate and gently crush any lumps present before using.

Source of Material: The NaCl used for this SRM was obtained from a commercial supplier. The material was examined for compliance with the specification for reagent grade NaCl as specified by the American Chemical Society [3]. The material was found to meet or exceed the minimum requirements in every respect.

Assay Techniques: The coulometric assay value was obtained by automated titration [4] with coulometrically generated Ag^+ using potentiometric detection of the endpoint. The gravimetric assay value was obtained by conversion of the Na present to Na_2SO_4, including corrections for trace impurities in the SRM (procedure based on reference 5).

NOTICE TO USERS

This SRM is for research use only.

NIST encourages the use of its SRMs to establish metrological traceability for the user's measurement results, and NIST strives to maintain the SRM inventory supply. However, NIST cannot guarantee the continued or continuous supply of any specific SRM. Accordingly, NIST encourages the use of SRMs as primary benchmarks for the quality and accuracy of the user's in-house (working) standards. As such, SRMs should be used to validate or otherwise assign values to the more routinely used standards in a laboratory. When the metrologically traceable values of such standards are assigned using this SRM for calibration, the uncertainties assigned to those values must include the uncertainty of the certified value of this SRM, appropriately combined with the uncertainties of the calibration measurements for the in-house standard. Comparisons between NIST SRMs and such working measurement standards should take place at intervals appropriate to the conservation of the SRM primary standard and the stability of relevant in-house standards. For further guidance on how this approach can be implemented, contact NIST by email at srms@nist.gov.

REFERENCES

[1] May, W.; Parris, R.; Beck II, C.; Fassett, J.; Greenberg, R.; Guenther, F.; Kramer, G.; Wise, S.; Gills, T.; Colbert, J.; Gettings, R.; MacDonald, B.; *Definition of Terms and Modes Used at NIST for Value Assignment of Reference Materials for Chemical Measurements*; NIST Special Publication 260-136; U.S. Government Printing Office: Washington, DC (2000); available at http://www.nist.gov/srm/upload/SP260-136.PDF (accessed Feb 2016).

[2] JCGM 100:2008; *Evaluation of Measurement Data - Guide to the Expression of Uncertainty in Measurement*; (GUM 1995 with Minor Corrections); Joint Committee for Guides in Metrology (JCGM) (2008); available at http://www.bipm.org/utils/common/documents/jcgm/JCGM_100_2008_E.pdf (accessed Feb 2016); see also Taylor, B.N.; Kuyatt, C.E.; *Guidelines for Evaluating and Expressing the Uncertainty of NIST Measurement Results*; NIST Technical Note 1297, U.S. Government Printing Office: Washington, DC (1994); available at http://www.nist.gov/pml/pubs/index.cfm (accessed Feb 2016).

[3] *Reagent Chemicals*, 9th ed.: American Chemical Society: Washington, DC (1999).

[4] Pratt, K.W.; *Automated, High-Precision Coulometric Titrimetry Part I. Engineering and Implementation*; Anal. Chim. Acta, Vol. 289, pp. 125–134 (1994).

[5] Moody, J.R.; Vetter, T.W.; *Development of the Ion Exchange-Gravimetric Method for Sodium in Serum as a Definitive Method*; J. Res. Natl. Inst. Stand. Technol., Vol. 101, pp. 155–164 (1996); available at http://nvl.nist.gov/pub/nistpubs/jres/101/2/j2mood.pdf (accessed Feb 2016).

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Users of this SRM should ensure that the Certificate of Analysis in their possession is current. This can be accomplished by contacting the SRM Program: telephone (301) 975-2200; fax (301) 948-3730; e-mail srminfo@nist.gov; or via the Internet at http://www.nist.gov/srm.